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ABSTRACT

An examination of the relationship between response latency during paired-associate learning and the subsequent retention in a computer assisted instruction (CAI) program was conducted in this experiment. Forty-five college students were presented nonsense syllables that had to be associated with key symbols on a response panel. The experiment found that good retention students demonstrated substantially longer latencies during acquisition than poor retention students. The investigators attributed this finding to the efficient employment of organizational strategies on the part of the good retention students. The investigators concluded that these data would indicate that the practical utility of response latency may be limited to situations in which a number of responses can be averaged to measure a characteristic of the learner rather than a characteristic of his momentary learning state. (MC)

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RESPONSE LATENCY AS A CORRELATE OF INDIVIDUAL DIFFERENCES IN RETENTION

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This experiment was the third in a series of studies (Judd & Glaser, 1969; Judd & Glaser, 1970) investigating response latency--the time required for a student to respond to a question. This research has been directed toward determining the utility of latency as a basis for instructional decisions in computer-assisted instruction (CAI). The purpose of the present experiment was to examine the relationship of response latency during paired-associate learning to subsequent retention.

The most striking characteristic of response latency during a verbal learning task is that there is a dramatic reduction in latency during overlearning. Since the amount of learned material retained at a later date is known to be a function of overlearning drill, it was postulated that the response latencies of subjects who demonstrated good retention would differ from the latencies of poor retention subjects. Specifically, it was hypothesized that good, as opposed to poor retention, subjects would demonstrate a sharper reduction in latency across the overlearning trials and would also have a shorter mean latency during overlearning. No systematic trends in latency had been observed during acquisition, or learning as opposed to overlearning. Consequently, no specific hypotheses were formed for these measures. The number of trials which subjects required to learn the list was also examined as a function of subsequent retention to evaluate the utility of combining speed of learning and latency as a predictor of retention.

Method

Subjects consisted of 45 undergraduates from The University of Pittsburgh who were paid for their participation. Stimulus items on the paired-associate list consisted of 24 CVC nonsence syllables with low association values (20 to 35 percent as determined by Archer (1960). Stimuli were presented on a cathode ray tube, a display similar to a small television screen. The subject's task was to associate the nonsense syllables with key positions on an eight-key response panel. Response latency was measured from the time at which the stimulus was displayed until the time the subject pressed a response key. The apparatus was controlled by a DEC PDP-7 computer which also recorded subjects' responses and timed their response latencies to within one millisecond.

The experiment consisted of two sessions, 48 hours apart. The first session began with a short practice list. The 24-item list was then presented by means of a study-test or recall paradigm. When an item reached a criterion of four successive errorless trials, it was dropped from the list. Practice continued until the subject accumulated 12 such items. In this way, a pool of 12 items was established for each subject in which the items were equivalent in terms of amount of overlearning practice. Only 12 of the 24 items were used in order to reduce the effect of diminishing list size. Subjects were instructed that when they returned in 48 hours for the second session, they would learn a new but similar list.

At the start of the second session, subjects were told that they would actually be relearning the original list. Again, there was a short practice list. Relearning trials on the 24-item list began with a test trial, after which study and test trials were alternated. Items were not dropped from the list and practice continued until all items reached a criterion of four successive errorless trials.

An item was defined as retained if all of the first four trials of the second session, including the initial test trial were errorless. An error on any of these four trials resulted in the item being defined as non-retained. Subjects were then categorized as being either good or poor retention subjects on the basis of a median split on the number of their retained items.

Results

Response latency is an extremely variable measure and systematic changes in latency are apparent only when responses to many items are averaged together. Each series of responses to a particular item contained a trial-of-last-error; that is, the trial immediately preceding that item's criterion series of four errorless trials. This trial divides that item's acquisition phase from its overlearning phase. Prior to computing latency means, the sequences of responses were all aligned on the basis of the items' trials-of-last-error. The resulting patterns of response latencies for good and poor retention subjects are shown in Figure 1.

The hypothesis that good retention subjects would demonstrate a sharper decrement in latency during overlearning was supported. For the good retention subjects, there was a 1.5 second reduction in latency across the four overlearning trials as compared to a reduction of 0.9 seconds for the poor retention subjects. This difference was significant ($p = .002$).

The hypothesis that good retention subjects would have a shorter mean latency during overlearning than would poor retention subjects was not supported. In fact, it was found that good retention subjects had significantly longer latencies during overlearning--a mean of 1.9 seconds as compared to 1.7 seconds for the poor retention subjects.

Contrary to expectation, there was a substantial difference between the latencies of good and poor retention subjects during acquisition. Good retention subjects had a mean latency which was 0.6 seconds longer than that of the poor retention subjects. Despite the high variability of latencies during acquisition, this difference was significant ($p = .021$). The slope difference between the two groups across the acquisition trials is more apparent than real. It is the result of complex trends and of the averaging procedures employed. The finding of primary interest is that the good retention subjects did have consistently longer latencies. As may be seen from Figure 1, this effect carried over into the overlearning trials, resulting in a reversal of the relationship which had been hypothesized. The difference between the two groups was finally eliminated on the fourth overlearning trial due to the sharper decrement of the good retention subjects.

Given the differences in response latency found between groups, it was asked whether this information could be used to predict retention. While there was a difference between groups on all but the last trial during overlearning, these differences were less substantial than during acquisition. Therefore, subjects' mean latency during acquisition was selected as the potential predictor. The product moment correlation between each subject's mean acquisition latency on the 12 experimental items and the number of those items defined as retained was found to be .47 ($p < .01$).

Good retention subjects were also found to be significantly faster learners than poor retention subjects ($p = .001$), requiring a mean of 1.4 fewer trials to bring an item to criterion. When the more stable measure of error rate was used as a predictor, the obtained correlation with subsequent retention was -.32 ($p < .05$). The multiple correlation, using both latency and error rate, was .53, a marginal improvement over latency alone ($p = .056$).

Discussion

The most interesting finding, we believe, is that good retention subjects demonstrated substantially longer latencies during acquisition. These same subjects required, on the average, only two-thirds as many trials to bring 12 items to criterion as did the poor retention subjects. It is quite likely that these subjects tended to employ organizational strategies, such as the use of mneumonic devices, which, while requiring more time for each response, were more efficient in terms of both acquisition and retention than were the strategies or lack of strategies used by the poor retention subjects. The nature of these results are suggestive of Kagan's categorization of "Impulsive" and "Reflective" children (Kagan, 1965; Kagan, Pearson, & Welch, 1966; Yando & Kagan, 1970), and of Rowher's findings with respect to elaborative learning skills (Rohwer, 1971).

Latency may well have a useful role as a basis for instructional decisions in CAI, but it is doubtful that its relationship to other performance measures is a simple one. Latency is a complex and variable measure. The comparative latencies of retained and non-retained items were also examined in this study, but only minor differences were found between the two types of items. These data would indicate that the practical utility of response latency may be limited to situations in which a number of responses can be averaged to measure a characteristic of the learner rather than a characteristic of his momentary learning state. If our speculation concerning the failure of the short latency subjects to use constructive learning strategies can be substantiated, response latency might be used in conjunction with error rate to reliably isolate such learners for the purpose of assigning them to an alternative instructional sequence.

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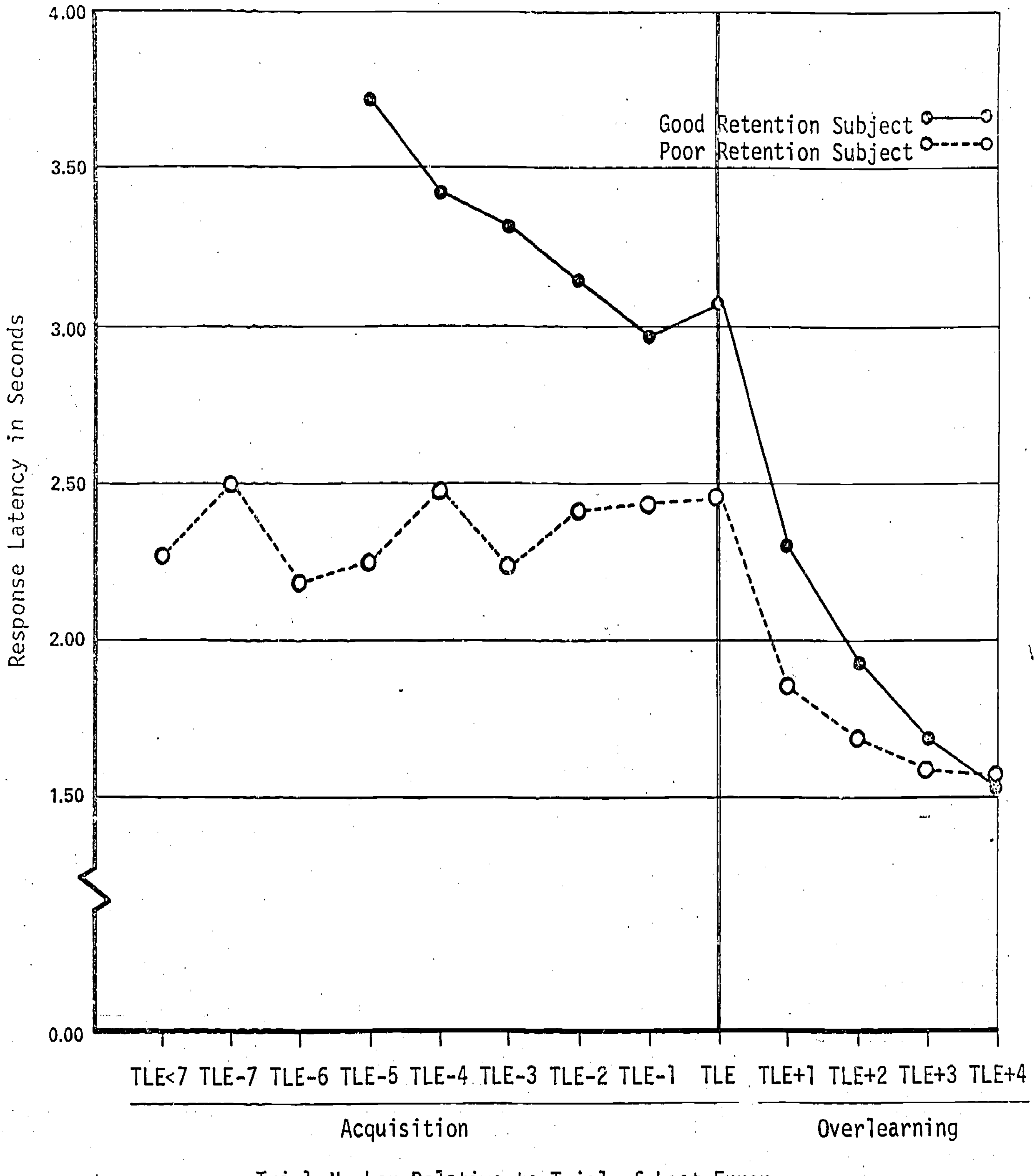

Figure 1. Response latencies of good and poor retention subjects during acquisition and overlearning.